

FORM PTO-1390 (Modified)
(REV 11-2000)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

**TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371**

SWR-0080

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

10/088154INTERNATIONAL APPLICATION NO.
PCT/EP00/08926INTERNATIONAL FILING DATE
13.09.2000PRIORITY DATE CLAIMED
9/14/1999 and 12/6/1999

TITLE OF INVENTION

BALL CAGE

APPLICANT(S) FOR DO/EO/US

**Franz-Josef Adams, Angel Alvarez-Mendez, Ralf Andreas Schellhaas, Volker Steude,
Peter Josef Strotgen and Guido Kochsiek**

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below.
4. ☐ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
 - a. ☒ is attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ has been communicated by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
 - a. ☒ is attached hereto.
 - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
 - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ have been communicated by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☐ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☒ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

Claim for Priority

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 1.53) 10/088154		INTERNATIONAL APPLICATION NO. PCT/EP00/08926		ATTORNEY'S DOCKET NUMBER SWR-0080	
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24. The following fees are submitted: BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) : <input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO \$1040.00 <input checked="" type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$890.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$740.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$710.00 <input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00 <p style="text-align: center;">ENTER APPROPRIATE BASIC FEE AMOUNT =</p>				CALCULATIONS PTO USE ONLY <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:50%; text-align: right;">\$890.00</td> <td style="width:50%;"></td> </tr> <tr> <td style="text-align: right;">\$0.00</td> <td></td> </tr> </table>		\$890.00		\$0.00	
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Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).				\$0.00					
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE						
Total claims	10 - 20 =	0	x \$18.00	\$0.00					
Independent claims	2 - 3 =	0	x \$84.00	\$0.00					
Multiple Dependent Claims (check if applicable) <input type="checkbox"/>				\$0.00					
TOTAL OF ABOVE CALCULATIONS =				\$890.00					
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.				\$0.00					
SUBTOTAL =				\$890.00					
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).				\$0.00					
TOTAL NATIONAL FEE =				\$890.00					
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable). <input type="checkbox"/>				\$0.00					
TOTAL FEES ENCLOSED =				\$890.00					
				Amount to be: refunded	\$				
				charged	\$				

a. ☒ A check in the amount of **\$890.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.


c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **06-1130** A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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23413
PATENT TRADEMARK OFFICE

Lisa Bongiovi

SIGNATURE

LISA A. BONGIOVI

NAME

48, 933

REGISTRATION NUMBER

MARCH 12, 2002

DATE

Express Mail Label # EL 831177248 US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF FRANZ-JOSEF ADAMS, ET AL

FOR: BALL CAGE

AMENDMENT

Commissioner of Patents and Trademarks
Washington, DC 20231

Dear Sir:

Before examining the present application, please amend as follows:

IN THE SPECIFICATION:

Please delete page 8.

Please insert the following section title before the first paragraph on the first page:

--FIELD OF THE INVENTION--

Please insert the following section title before the second paragraph on the first page:

--DESCRIPTION OF THE RELATED ART--

Please insert the following section title before the third paragraph on the fourth page:

--SUMMARY OF THE INVENTION--

"Express Mail" mailing label number EL 83117724805
Date of Deposit March 12, 2002
I hereby certify that this paper or fee is being deposited
with the United States Postal Service "Express Mail
Post Office to Addressee" service under 37 CFR 1.10
on the date indicated above and is addressed to the
Commissioner of Patents and Trademarks, Washington,
D.C. 20231
NORMAN DEKAS
(Typed or printed name of person mailing paper or fee)
NORMAN DEKAS
(Signature of person mailing paper or fee)

Please insert the following section title before the second complete paragraph on page five, that is, before the paragraph beginning, "Further benefits and features * * *":
--BRIEF DESCRIPTION OF THE DRAWINGS--

Please insert the following section title before the third paragraph on page six, that is, before the paragraph beginning, "The ball cage shown in Fig. 1 * * *":
--DETAILED DESCRIPTION--

IN THE CLAIMS:

Please amend the following claims in "clean" format:

1. (Amended) Ball cage for homokinetic joints, formed from a blank that is configured as a substantially annular spherical segment, the ball cage comprising:

window-type ball pockets located along an equator with substantially equator-parallel bearing surfaces that interact with joint balls, with substantially annular functional zones that are designed at least on outer ring edge areas and that interact with a joint bell, and with substantially annular functional areas that are designed on inner ring areas and interact with the joint spider, wherein on the blank at least some of the functional zones are elevated compared to the neighboring areas of the ball cage.

2. (Amended) Ball cage pursuant to claim 1, wherein the blank is hardened before finishing the functional zones.

3. (Amended) Ball cage pursuant to claim 2, wherein on the hardened blank only the elevated functional zones are processed through hard-turning.

4. (Amended) Ball cage pursuant to claim 1, wherein the blank contains turned, preferable hard-turned reference surfaces.

5. (Amended) Ball cage pursuant to claim 1, wherein the functional zones, which have been hard-turned, are elevated compared to adjacent surfaces after a finishing process or are at the most on a same level.

6. (Amended) Ball cage pursuant to claim 1, wherein the blank is formed in a rolling process.

7. (Amended) Ball cage pursuant to claim 1, wherein window-type ball pockets are stamped.

8. (Amended) Ball cage pursuant to claim 7, wherein the window-type ball pockets have such dimensions that the surfaces, on which the equator-parallel functional zones are designed, are longer than these and protrude on both sides beyond the functional zone.

9. (Amended) Ball cage for homokinetic joints, formed from a blank that is configured as a substantially annular spherical segment, the ball cage comprising:

window-type ball pockets located along the equator with substantially equator-parallel bearing surfaces that interact with the joint balls, with several substantially annular functional zones that are designed on outer ring edge areas and that interact with a joint bell, and with several substantially annular functional areas that are designed on inner ring areas and interact with the joint spider, wherein on a finished component at least some of the functional zones are elevated compared to adjacent surfaces or have at least a same level.

10. (Amended) Ball cage pursuant to claim 9, wherein the cage has functional zones that have an elevated design on fin areas, which separate the ball pockets, and has functional zones that have been hard-turned.

IN THE ABSTRACT:

Please add the following abstract on the page following the claims:

“ABSTRACT

Ball cage for homokinetic joints, formed from a blank that is configured as a substantially annular spherical segment, the ball cage includes: window-type ball pockets located along an equator with substantially equator-parallel bearing surfaces that interact with joint balls, with substantially annular functional zones that are designed at least on outer ring edge areas and that interact with a joint bell, and with substantially annular functional areas that are designed on inner ring areas and interact with the joint spider, wherein on the blank at least some of the functional zones are elevated compared to the neighboring areas of the ball cage.”

REMARKS

Applicants request entry of the present amendments that conform the claims to U.S. practice. No new matter is being introduced by this Amendment as antecedent support is set forth in the original specification and in the original claims. Attached hereto is a marked-up version of the changes made. The attached page is captioned "**Version with Markings to Show Changes Made.**"

Prosecution on the merits is respectfully requested.


The Examiner is invited to contact Applicant's Attorneys at the below-listed telephone number regarding this Preliminary Amendment or otherwise regarding the present application.

If there are any charges with respect to this Amendment or otherwise, please charge them to Deposit Account No. 06-1130 maintained by Applicants' attorneys.

Respectfully submitted,

FRANZ-JOSEF ADAMS, ET AL.

CANTOR COLBURN LLP
Applicants' Attorneys

By: 
Lisa A. Bongiovi
Registration No. 48,933
Customer No. 23413

Date: March 12, 2002
Address: 55 Griffin Road South, Bloomfield, CT 06002
Telephone: 860-286-2929

MARKED UP VERSION TO SHOW CHANGES MADE

IN THE CLAIMS:

A marked-up version of the Claims is as follows:

1. (Marked up/Amended) Ball cage for homokinetic joints, formed from a blank that is configured as a substantially annular spherical segment, the ball cage comprising: with

window-type ball pockets located along ~~the~~an equator with substantially equator-parallel bearing surfaces that interact with ~~the~~ joint balls, with substantially annular functional zones that are designed at least on ~~the~~ outer ring edge areas and that interact with a joint bell, and with substantially annular functional areas that are designed on ~~the~~ inner ring areas and interact with the joint spider,

~~—— characterized by the fact~~

~~—— that wherein~~ on the blank at least some of the functional zones are elevated compared to the neighboring areas of the ball cage.

2. (Marked up/Amended) Ball cage pursuant to claim 1, ~~characterized by the fact that wherein~~ the blank is hardened before finishing the functional zones.

3. (Marked up/Amended) Ball cage pursuant to ~~one of the previous claims~~claim 2, ~~characterized by the fact that wherein~~ on the hardened blank only the elevated functional zones are processed through hard-turning.

4. (Marked up/Amended) Ball cage pursuant to ~~one of the previous claims~~claim 1, ~~characterized by the fact that wherein the blank~~ it contains turned, preferable hard-turned reference surfaces.

5. (Marked up/Amended) Ball cage pursuant to ~~one of the previous claims~~claim 1, ~~characterized by the fact that wherein~~ the functional zones, which have been hard-turned, are elevated compared to adjacent surfaces after ~~the~~a finishing process or are at the most on ~~the~~a same level.

6. (Marked up/Amended) Ball cage pursuant to ~~one of the previous claims~~claim 1, ~~characterized by the fact that wherein~~ the blank is formed in a rolling process.

7. (Marked up/Amended) Ball cage pursuant to ~~one of the previous claims~~claim 1, ~~characterized by the fact that wherein~~ the recesses window-type ball pockets are stamped.

8. (Marked up/Amended) Ball cage pursuant to ~~one of the previous claims~~ claim 7, ~~characterized by the fact that~~ wherein the window-type ~~reeesses~~ ball pockets have such dimensions that the surfaces, on which the equator-parallel functional zones are designed, are longer than these and protrude on both sides beyond the functional zone.

9. (Marked up/Amended) Ball cage for homokinetic joints, formed from a blank that is configured as a substantially annular spherical segment, the ball cage comprising:

~~with~~ window-type ball pockets located along the equator with substantially equator-parallel bearing surfaces that interact with the joint balls, with several substantially annular functional zones that are designed on ~~the~~ outer ring edge areas and that interact with a joint bell, and with several substantially annular functional areas that are designed on ~~the~~ inner ring areas and interact with the joint spider, ~~characterized by the fact that~~ wherein on ~~the a~~ finished component at least some of the functional zones are elevated compared to the adjacent surfaces or have at least ~~the a~~ same level.

10. (Marked up/Amended) Ball cage pursuant to ~~one of the claims 1 through 9~~, ~~characterized by the fact that~~ wherein ~~this~~ the cage has functional zones that have an elevated design on ~~the~~ fin areas, which separate the ball pockets, and has functional zones that have been hard-turned.

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Ball Cage

The present invention relates to a ball cage for homokinetic joints, formed from a blank that is configured as a substantially annular spherical segment, with window-type ball pockets located along the equator with substantially equator-parallel bearing surfaces that interact with the joint balls, with substantially annular functional zones that are located on the outer ring edges and interact with the joint bell, and with substantially annular functional surfaces that are located on the inner ring edges and interact with the joint spider.

Ball cages form together with the so-called joint bell – also called axle journal -, the ball hub – also called the joint spider – as well as the balls the essential elements of a fixed joint. The elements ball cage axle journal and ball cage ball hub are paired with clearance fit, wherein the remaining finished part tolerances are within the range of just a few micrometers for functional reasons. Ball cages of the conventional design are characterized by a continuous shape of those surfaces of the component that are in contact with the axle journal to the outside and with the ball hub to the inside. Both the exterior contour as well as the interior contour, respectively, of the annular spherical segments are shaped as a radius, which extends from the one lateral periphery via the fin area to the opposite other periphery.

In motor vehicles with front-wheel drive, the steered wheels are driven. Therefore front wheel axle shafts must have joints, which permit both the compression and rebound of the wheels as well as their steering angle. In order to enable as uniform a drive of the wheels as possible, homokinetic joints are used. For joints on the front axle shaft, but also on the rear axles, among other things fixed homokinetic joints are designed as the joints, while for joints on the rear axle shaft shifting homokinetic joints are used, which apart from a flexion of the joint also permit axial displacement.

On the fixed homokinetic joint, ball cup and ball spider have arched paths on which the balls travel. On the shifting homokinetic joint, the travel paths on the ball cup and ball spider are plane. Such ball cages have an annular design and annular spherical segment shapes. The material of these spherically designed rings is several millimeters strong. The window-type ball pockets along the equator have functional zones, which interact with the joint balls, in the substantially equator-parallel edges. On the upper and lower outer ring areas, peripheral annular functional zones are formed, which serve the purpose of interaction between the ball cage and a joint bell. In the interior area, annular surfaces are designed above and beneath the window-type recesses as functional zones, which serve the purpose of interaction between the ball cage and the joint spider. The homokinetic joint should practically have no play so that the interacting areas of ball cage, joint bell and joint spider are subject to very tight tolerance settings.

In homokinetic joints that we know from practice, which consist of ball spider, ball cage and ball cup, the ball cages, which are equipped with annular interior and exterior bearing surfaces and ball pockets for seating the torque-transmitting balls, are produced in a variety of operations on various machines. Starting from a hollow tube, which has roughly the same outer diameter as the ball cage that is supposed to be manufactured, initially a

section of the tube is separated from the starting tube in familiar production methods for the ball cage's blanks, with this section's width roughly corresponding to the width of the ball cage that is supposed to be manufactured. Subsequently, the annular inner and outer bearing surfaces are formed in a forging process, then turned and the ball pockets are stamped out of the annular bearing surfaces on another machine before these blanks reach the finishing process after hardening.

The disadvantage with these familiar manufacturing processes is on one hand the fact that the production of each ball cage comprises several operations that have to be performed on different machines and on the other hand the fact that in forging and stamping of the ball pockets structural disturbances and tensions are created in the material of the ball cage. Due to this multitude of operations on different machines, the production of these ball cages is time-intensive and expensive. We also know that a blank is hardened and machined to the tolerance dimension on all surfaces through appropriate processes, usually hard-turning. This creates very exact and smooth functional surfaces. Since fixed joints are generally designed so as to be able to transmit great forces also under flexion with an appropriate service life, the materials that are used are exclusively hardened steels. In order to be able to adhere to the tight manufacturing tolerances, finishing generally occurs on the hardened component. This occurs conventionally through a machining process with a geometrically undefined cutter, e.g. hard-turning or hard-milling.

A problem in the hard-finishing of ball cages that has not been resolved so far consists of the fact that due to the windows that are inserted on the circumference an interrupted cut is created in the area of the fins, while the tool operates in a continuous cut in the areas lateral to the fins. The stress due to the interrupted cut on one hand and the change in the stress type from continuous to interrupted on the other hand has an unfavorable effect on the tool life.

For the processing of the hardened steel, special machining elements must be used, which are generally of very high quality and cost-intensive.

Due to the interrupted cut, only comparatively low cutting speeds can be set since otherwise the cutters are exposed to increased wear all the way to breakage of the cutter. It has also been proven that the firmness of the ball cage that is supposed to be finished is subject to the notch effect and has a limited stability due to the surface machining process, which causes an uncontrolled interruption in the surface structure of the forging, i.e. a disturbance of the so-called fiber orientation.

Overall the manufacturing of ball cages of the described kind is very complex, scrap rates and tool requirements are relatively high and the finished ball cages are still very expensive despite intensive mass production.

Starting from the above-described state of the art, the present invention is based on the task of further developing a ball cage of the described kind in such a way that it can be manufactured with shorter machining times in a more economical and simple way.

For resolving this task from a technical point of view, the invention suggests to have at least some of the functional zones of the blank raised compared to the adjacent surfaces of the ball cage.

Due to the invented design of the blank's functional areas, which are elevated compared to the neighboring areas, there is now the possibility to limit finishing, preferably through hard-turning, to the functional areas or some functional areas. Consequently only a few areas are machined, the interrupted cut due to further processing of the fins remaining between the window-type recesses is eliminated and the elevation of the functional areas can be designed in such a way that the functional areas are still raised compared to the neighboring surfaces after the finishing process or at most are at the same level.

The ball cage is preferably rolled during manufacturing, i.e. shaped through rolling from one tubular piece. The window-type ball pockets are stamped pursuant to a beneficial

suggestion of the invention, wherein the ball bearing surfaces, i.e. the equator-parallel surfaces, can be produced with an allowance. The particular advantage results during the turning of these surfaces since the path of the cutter tooth has a better course under better cutting conditions. This is especially true when only the bearing surface itself has an allowance, the ball pocket itself however is considerably longer so that on both sides free space that does not have to be finished remains. Through the rolling process, no notch forces are exercised on the blank, which results in a homogenous fiber orientation of the material so that overall greater stability is achieved, which leads to a longer life.

Overall, the allowance on the hardened functional areas, which are supposed to be machined through a turning process, considerably reduces the machining time since the turning speeds of the work piece can be increased drastically, e.g. doubled. Due to the fact that an interrupted cut is largely avoidable, the machining time can be shortened through higher speeds, and possible problems for the machining tools are cut to a minimum.

Further benefits and features of the invention result from the following description based on the figures. They show:

- Fig. 1 a semi-cut side view of an embodiment of a ball cage;
- Fig. 2 a semi-cut side view of an alternative embodiment of a ball cage;
- Fig. 3 a semi-cut side view of an alternative embodiment of a ball cage;
- Fig. 4 a semi-cut side view of an alternative embodiment of a ball cage;

Fig. 5 a semi-cut side view of an alternative embodiment of a ball cage;

Fig. 6 a semi-cut side view of an alternative embodiment of a ball cage.

The ball cage 1 shown in Fig. 1 consists of an annular spherical segment 2. Along the equator, shown by the center line 3, ball pockets 4 are designed, which contain ball bearing surfaces 5. The ball bearing surfaces 5 only take up a portion of the substantially equator-parallel edge 6 of the ball pocket so that free space is created on both sides. Annular functional zones 7 for the process with the joint spider and 9 for the interaction with the joint bell are incorporated in the ring interior or ring exterior. As the figure shows, all functional zones have an allowance, i.e. the areas 7 and 9. Also the ball bearing surfaces 5 have an allowance. Upon production of the blank through a rolling process and the incorporation of the ball pockets, for example through a stamping process, the blank is hardened. Subsequently, the functional zones that have an allowance are processed in a turning process and brought to the finished dimension. Only the surfaces 5, 7 and 9 must be processed. The reference or working surfaces such as the annular area 8 or a plane reference edge 10 are manufactured accordingly during the turning process.

This shows that on the entire area 11 no processing at all has to take place, thus avoiding any interrupted cuts. By incorporating the allowance, the functional zones can be processed pursuant to the tolerance requirements and are even after completion either still elevated compared to the remaining surfaces or at the most on the same level.

The invented design of the blank, according to which the entire area 11 can remain unprocessed since no functional surfaces must be incorporated there, causes a considerable reduction in machining time and a simplification of the manufacturing process.

Fig. 2 shows a ball cage like in Fig. 1, except that in the fin area 11 additionally at least one support surface outside 13 and at least one support surface inside 12 are provided, which also have to be processed.

Fig. 3 shows a ball cage like in Fig. 1, except that only the outer annular functional areas 9 are elevated, while the inner functional area 7 is not elevated.

Fig. 4 shows a ball cage like in Fig. 3, except that in the fin area 11 additionally at least one support surface outside 13 is provided, which also has to be processed.

Fig. 5 shows a ball cage like in Fig. 1, except that only the inner annular functional areas 7 are elevated, while the outer functional area 9 is not elevated.

Fig. 6 shows a ball cage like in Fig. 5, except that in the fin area 11 additionally at least one support surface inside 12 is provided, which also has to be processed.

The described embodiment serves the purpose of explanation and does not have a limiting effect.

Reference List

- 1 ball cage
- 2 annular spherical segment
- 3 equator
- 4 ball pocket
- 5 bearing surface
- 6 equator-parallel edge
- 7 annular functional zone
- 7' annular functional zone
- 8 reference/working surface
- 9 annular functional zone
- 9' annular functional zone
- 10 reference/working surface
- 11 unfinished area
- 12 support area inside
- 13 support area outside

Patent Claims

1. Ball cage for homokinetic joints, formed from a blank that is configured as a substantially annular spherical segment, with window-type ball pockets located along the equator with substantially equator-parallel bearing surfaces that interact with the joint balls, with substantially annular functional zones that are designed at least on the outer ring edge areas and that interact with a joint bell, and with substantially annular functional areas that are designed on the inner ring areas and interact with the joint spider, characterized by the fact that on the blank at least some of the functional zones are elevated compared to the neighboring areas of the ball cage.
2. Ball cage pursuant to claim 1, characterized by the fact that the blank is hardened before finishing the functional zones.
3. Ball cage pursuant to one of the previous claims, characterized by the fact that on the hardened blank only the elevated functional zones are processed through hard-turning.
4. Ball cage pursuant to one of the previous claims, characterized by the fact that it contains turned, preferable hard-turned reference surfaces.
5. Ball cage pursuant to one of the previous claims, characterized by the fact that the functional zones, which have been hard-turned, are elevated compared to adjacent surfaces after the finishing process or are at the most on the same level.
6. Ball cage pursuant to one of the previous claims, characterized by the fact that the blank is formed in a rolling process.

7. Ball cage pursuant to one of the previous claims, characterized by the fact that the recesses are stamped.
8. Ball cage pursuant to one of the previous claims, characterized by the fact that the window-type recesses have such dimensions that the surfaces, on which the equator-parallel functional zones are designed, are longer than these and protrude on both sides beyond the functional zone.
9. Ball cage for homokinetic joints, formed from a blank that is configured as a substantially annular spherical segment, with window-type ball pockets located along the equator with substantially equator-parallel bearing surfaces that interact with the joint balls, with several substantially annular functional zones that are designed on the outer ring edge areas and that interact with a joint bell, and with several substantially annular functional areas that are designed on the inner ring areas and interact with the joint spider, characterized by the fact that on the finished component at least some of the functional zones are elevated compared to the adjacent surfaces or have at least the same level.
10. Ball cage pursuant to one of the claims 1 through 9, characterized by the fact that this cage has functional zones that have an elevated design on the fin areas, which separate the ball pockets, and has functional zones that have been hard-turned.

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES
PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG(19) Weltorganisation für geistiges Eigentum
Internationales Büro(43) Internationales Veröffentlichungsdatum
22. März 2001 (22.03.2001)

PCT

(10) Internationale Veröffentlichungsnummer
WO 01/20185 A1(51) Internationale Patentklassifikation⁷: **F16D 3/223**

(21) Internationales Aktenzeichen: PCT/EP00/08926

(22) Internationales Anmeldedatum:
13. September 2000 (13.09.2000)

(25) Einreichungssprache: Deutsch

(26) Veröffentlichungssprache: Deutsch

(30) Angaben zur Priorität:
99118232.0 14. September 1999 (14.09.1999) EP
199 58 719.1 6. Dezember 1999 (06.12.1999) DE(71) Anmelder (für alle Bestimmungsstaaten mit Ausnahme von US): **IPROTEC MASCHINEN- UND EDELSTAHLPRODUKTE GMBH** [DE/DE]; Friedewalder Strasse 50, 32469 Petershagen-Friedewalde (DE). **FORD-WERKE AKTIENGESELLSCHAFT** [DE/DE]; Henry-Ford-Strasse 1, 50725 Köln (DE).

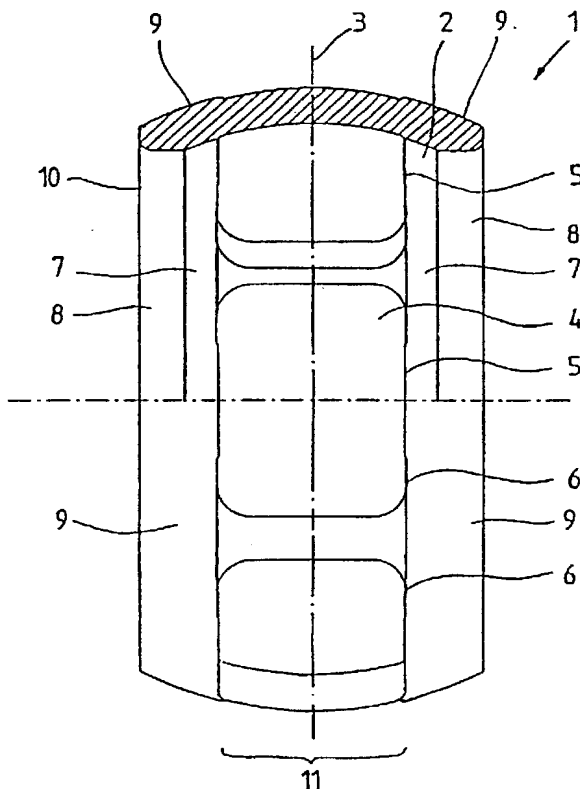
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[Fortsetzung auf der nächsten Seite]

(54) Title: BALL CAGE

(54) Bezeichnung: KUGELKÄFIG



(57) **Abstract:** The invention relates to a ball cage for homokinetic joints. The aim of the invention is to produce such ball cages in shorter processing times using a more economic and simpler method. To this end, the ball cage that consists of a blank (1) is configured as a substantially annular spherical segment (2) with window-type ball pockets (4) located along the equator with substantially equator-parallel bearing surfaces (5) that interact with the bearing balls. Substantially annular functional zones (9) are located on the outer ring edges (6) and interact with a joint bell and with substantially annular functional zones (7) that are located on the inner ring zones and that interact with the joint spider. The inventive ball cage is especially characterized in that at least some of the functional zones of the blank are raised vis-à-vis the adjoining surfaces of the ball cage.

(57) **Zusammenfassung:** Um einen Kugelkäfig für Gleichlaufgelenke, gebildet aus einem Rohling (1) in Form eines im wesentlichen ringförmigen Kugelsegmentes (2), mit entlang des Äquators angeordneten fensterartigen Kugeltaschen (4) mit im wesentlichen äquatorparallel ausgebildeten Anlageflächen (5) für das Zusammenwirken mit Gelenkkugeln, mit an den äusseren Ringkantenbereichen (6) ausgebildeten, im wesentlichen ringförmig verlaufenden Funktionsflächen (9) für das Zusammenwirken mit einer Gelenkglocke und mit an inneren Ringbereichen ausgebildeten, im wesentlichen ringförmig verlaufenden Funktionsflächen (7) für das Zusammenwirken mit einem Gelenkstern, dahingehend weiterzubilden, dass dieser in kürzeren Bearbeitungszeiten wirtschaftlicher und einfacher herstellbar ist, wird mit der Erfindung vorgeschlagen, dass bei dem Rohling wenigstens einige der Funktionsflächen gegenüber benachbarten Flächen des Kugelkäfigs erhaben

ausgebildet sind.

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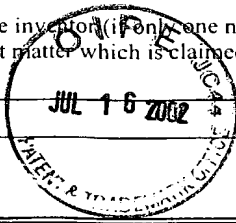
Combined Declaration for Patent Application and Power of Attorney

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

BALL CAGE



the specification of which

(check one) ☐ is attached hereto.

☒ was filed on 3/12/2002 as Application Serial No. 10/088,154
and (if applicable) was amended on:

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
99118232.0 (Number)	EP (Country)	14.09.1999 (Day Month Year Filed)	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
199 58 719.1 (Number)	DE (Country)	06.12.1999 (Day Month Year Filed)	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
 (Number)	 (Country)	 (Day Month Year Filed)	<input type="checkbox"/> YES	<input type="checkbox"/> NO
 (Number)	 (Country)	 (Day Month Year Filed)	<input type="checkbox"/> YES	<input type="checkbox"/> NO
 (Number)	 (Country)	 (Day Month Year Filed)	<input type="checkbox"/> YES	<input type="checkbox"/> NO
 (Number)	 (Country)	 (Day Month Year Filed)	<input type="checkbox"/> YES	<input type="checkbox"/> NO

I hereby claim the benefit under Title 35, United States Code, §120 of any United States Application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulation, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

 (Application Serial No.)	 (Filing Date)	 (Status- patented, pending, abandoned)
 (Application Serial No.)	 (Filing Date)	 (Status- patented, pending, abandoned)

I hereby appoint the following attorneys, with full power of substitution, association, and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

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11 PCT/PTO 16 JUL 2002

Change Of Attorney Or Agent's Address In Application
(37 CFR 1.8(a))

Docket No. ... #6
SWR-0080

In Re Application Of: **Franz-Josef Adams, et al**

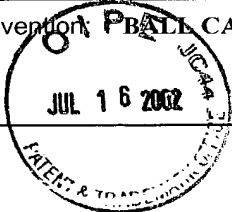
Serial No.
10/088,154

I. A. Filing Date
9/13/2000

Examiner

Group Art Unit

Inventor: **PBALL CAGE**



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I certify that this document is being deposited on
JULY 10, 2002 with the U.S. Postal Service as first
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I hereby further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application of any patent issued thereon.

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